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# *Shared Information and Virtual Surfaces*

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# *Objective*

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- Investigate performance of self-synchronizing teams
- Understand how teams collaborate in situations characterized by high stakes, time pressure and uncertainty

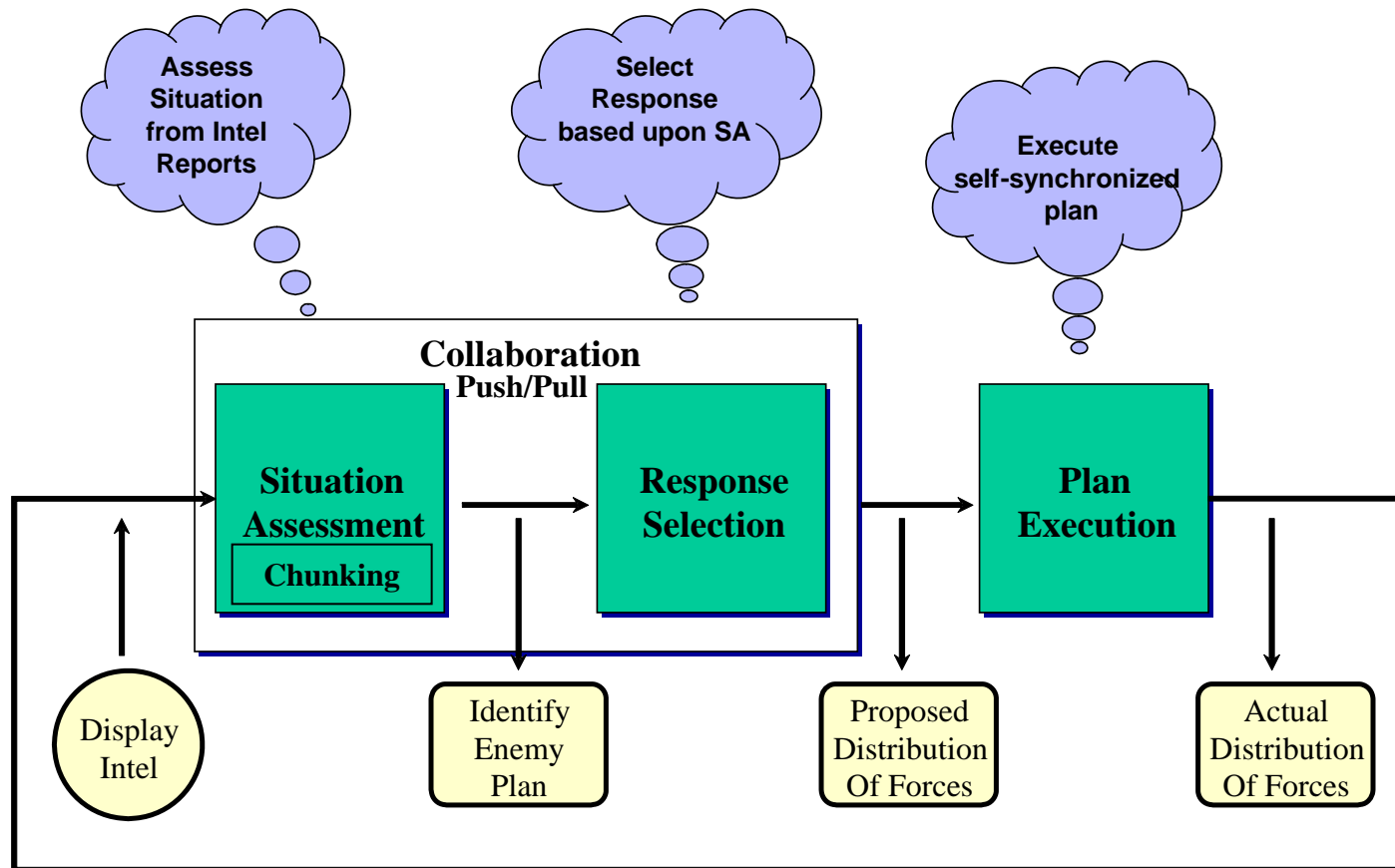
# *Research Vision*

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***Problem:*** teams have difficulty coordinating their actions in real-time

***Question:*** how can we support teams operating in rapidly changing environments?

# Research Model



Empirical investigation of our model of  
**Team Recognition Primed Decision Making**

# *Team Compensatory Aids*

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- **Perception Tools for**
  - *Pattern Recognition*
  - *Sharing of Intention*
- **Attention Tools for**
  - *Gesturing*
  - Alerting (negotiated)
  - Awareness
- **Memory Aids for**
  - Mitigating the Effects of Stress

# *Research Measures*

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- Outcome Measures: *Quality, Speed*
- Process Measures:
  - *Pattern Recognition, Confidence*
  - *Information Sharing, Intention*
  - *Collaboration*
  - *Leadership*
- Mental Models: *Pathfinder C*

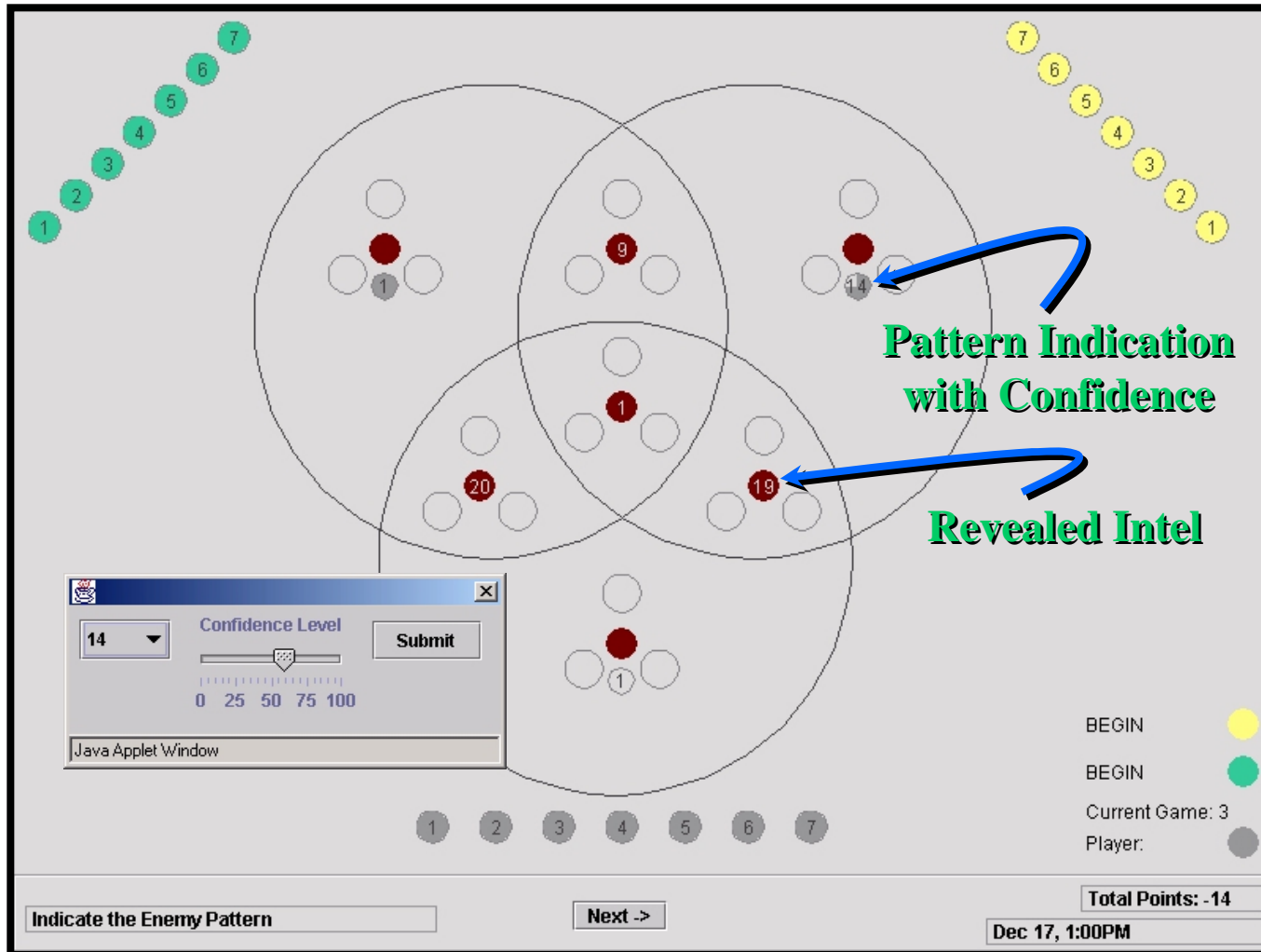
# *Decision Game*

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- Cooperative 3-Player Game
- 7 Tokens, numbered 1-7
- Opponent has asymmetric force
  - Patterns: Definitive, Equivocal, Uncertain
- Team places tokens so total  $\geq$  opponent
- Play is interactive



# Game Screen



The game screen displays a Venn diagram with three overlapping circles. Each circle contains a set of smaller circles, some of which are numbered. The numbers are: 1, 9, 14, 1, 20, 19, and 1. The circles are arranged in a triangular pattern. The background is light gray. The interface includes a 'Confidence Level' slider set to 14, a 'Submit' button, and a 'Next ->' button. The bottom of the screen shows 'Indicate the Enemy Pattern', 'Total Points: -14', and 'Dec 17, 1:00PM'. The top corners feature sequences of numbered circles (green and yellow) and a legend on the right side.

**Pattern Indication with Confidence**

**Revealed Intel**

Confidence Level: 14

Submit

Java Applet Window

Indicate the Enemy Pattern

Next ->

Total Points: -14

Dec 17, 1:00PM

BEGIN

BEGIN

Current Game: 3

Player:

\_\_\_\_\_

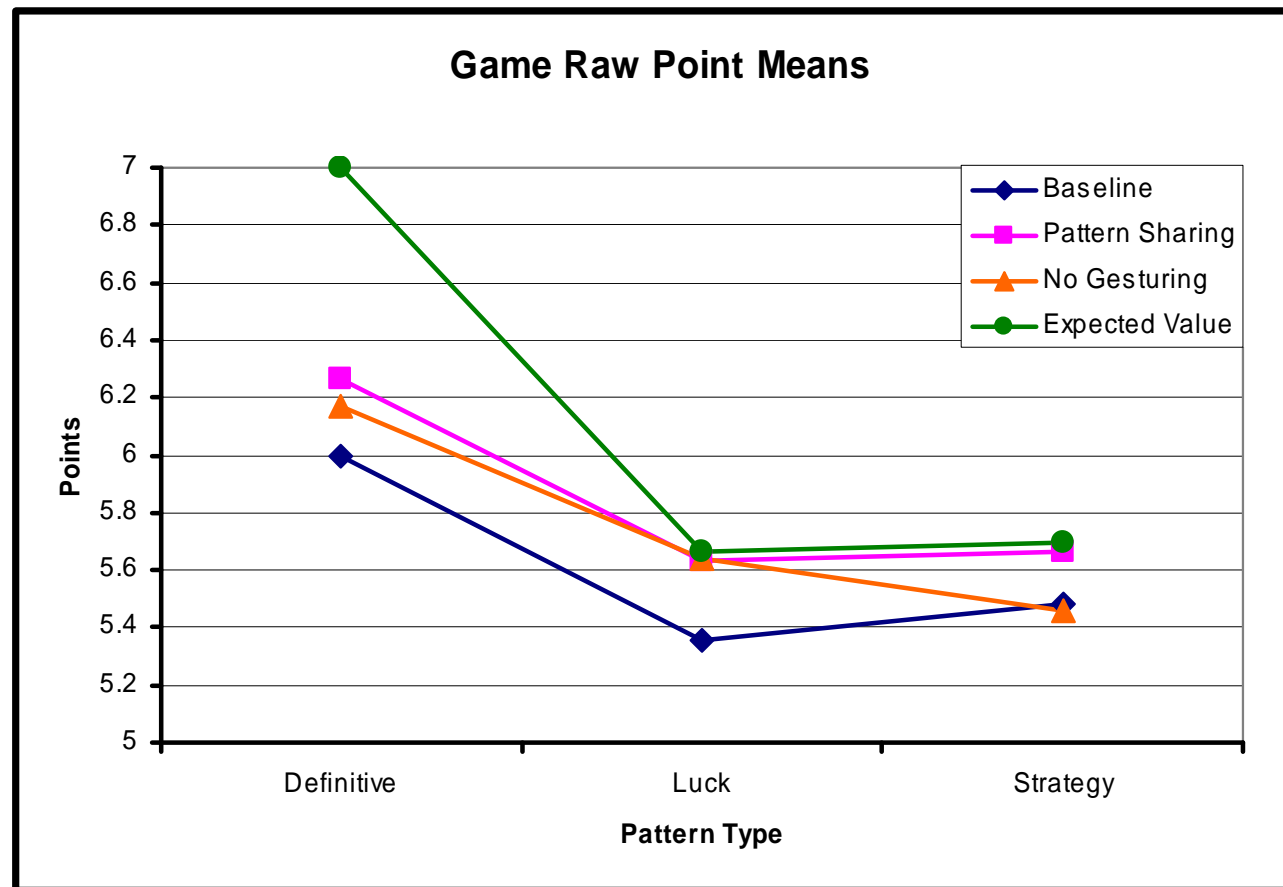


## *Current Progress*

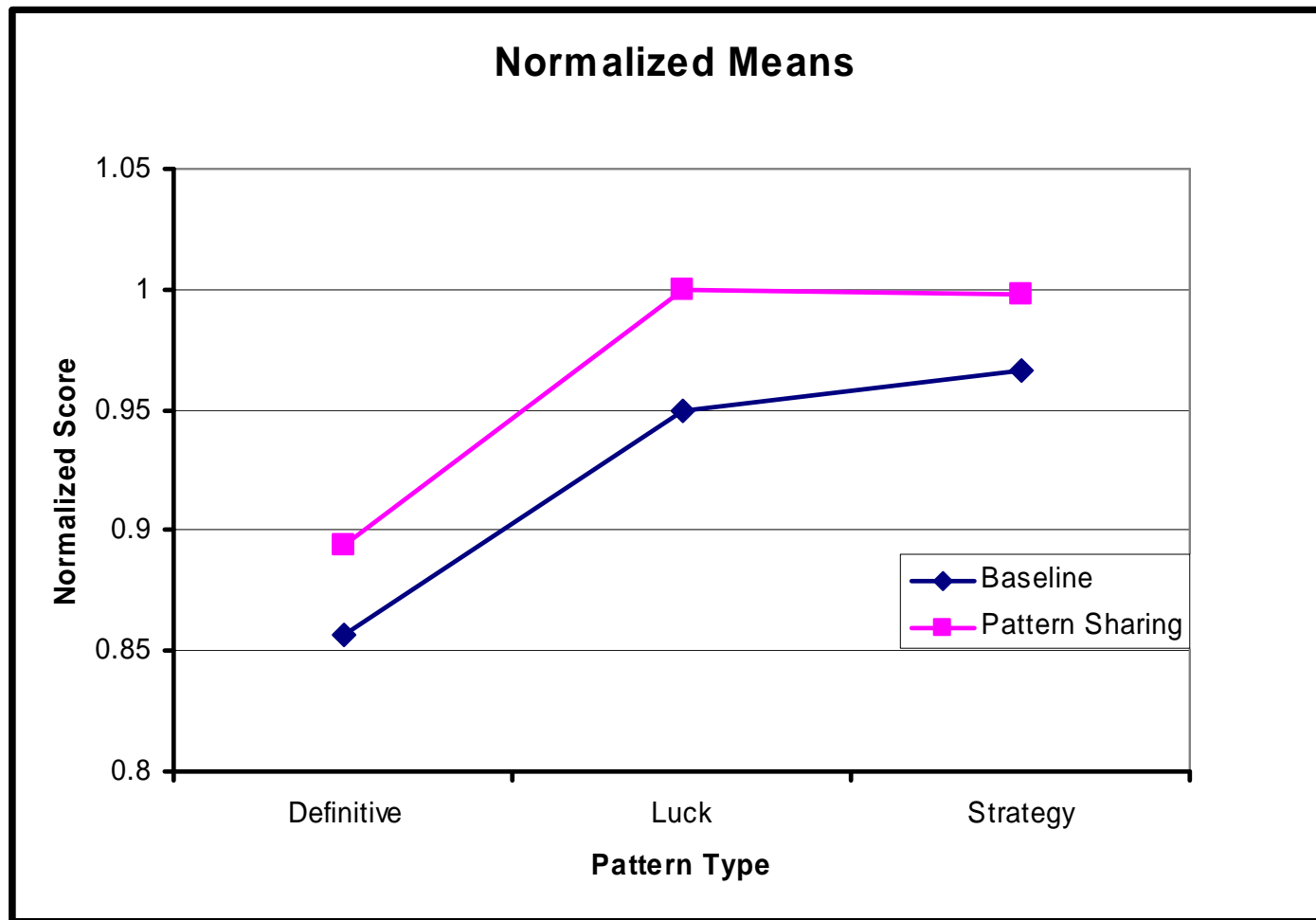
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- Model and Software Developed
- Data Collected:
  - 144 Participants, 3 Treatments
- Analysis Performed
- Findings Reported

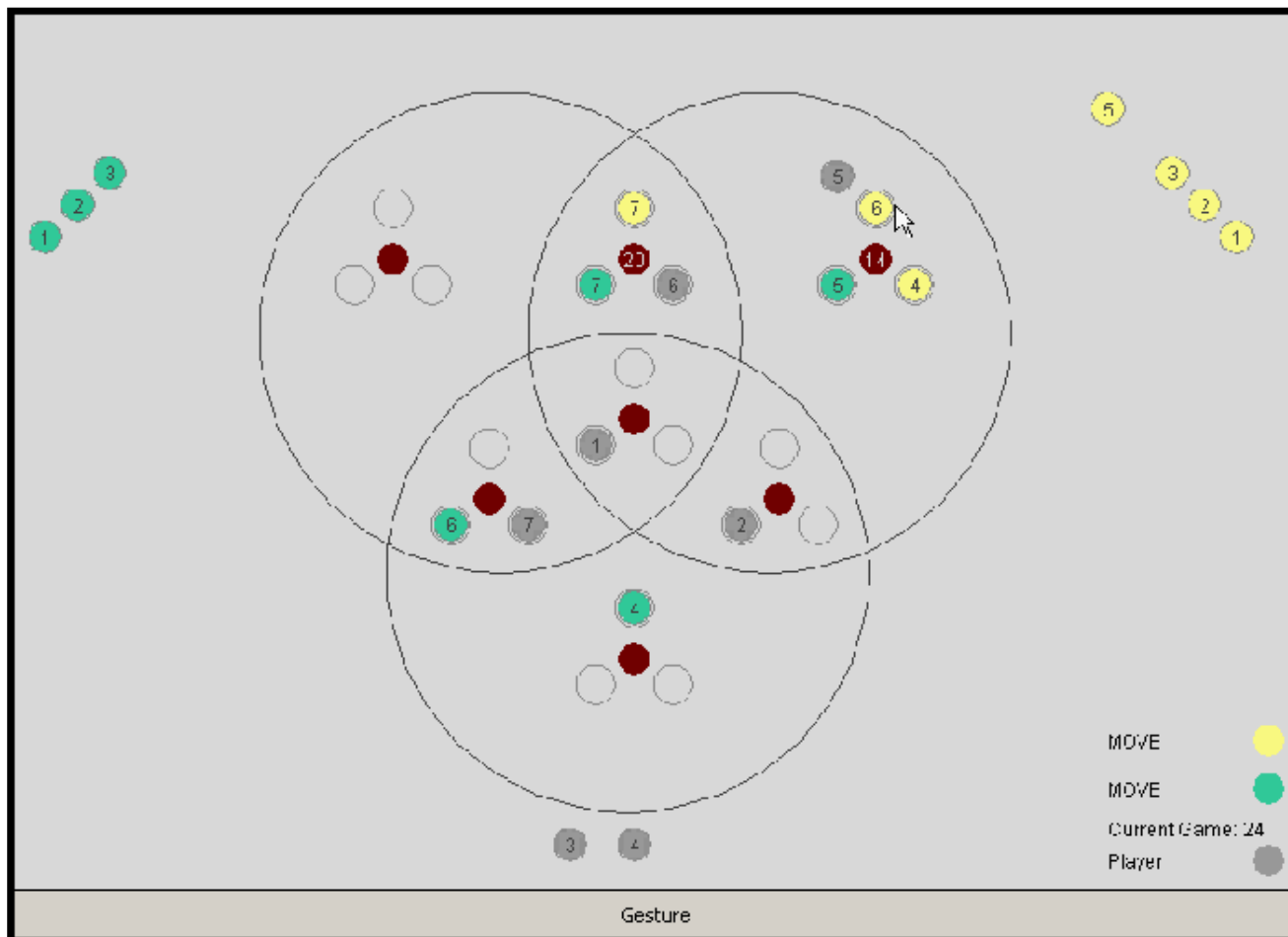
# Raw Scores



# *Normalized Scores*



# *Gesturing Example*



# *Conclusions*

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- Team Recognition Primed Decision Making Model Validated
  - More time spent in situation assessment than in response selection
  - Pattern sharing reduces “extra” movement by 50%
  - Surprise finding wrt importance of real-time gesturing

# Research Issues

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- Shared Mental Models
  - Similar or compatible knowledge  
Cannon-Bowers, J. E. & Salas, E. (2001)  
“[Reflections on Shared Cognition](#)”, *Journal of Organizational Behavior*, 22(March):195-202
  - Consensus on who knows what  
Kraut, R. E., Lerch, F. J., & Fussell, S. R. *The Development of Shared Mental Models and Group Performance* ([NSF IIS-9812123](#))



# Research Issues

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- Team Cognitive Chunks

- Slots and Templates

Gobet, F. & Simon, H. A. (in press)

*“Five Seconds or Sixty? Presentation Time in Expert Memory”*, Cognitive Science.

- Labels and Mnemonics

Staszewski, J. (1990). Exceptional memory: The influence of practice and knowledge on the development of elaborative encoding strategies. In F. E. Weinert & W. Schneider (Eds.), *Interactions among aptitudes, strategies, and knowledge in cognitive performance*, (pp. 252-285). New York: Springer.

# Research Issues

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- Attention Management

- Negotiated Alerts

Horvitz, E., Jacobs, A., & Hovel, D. (1999) “[\*Attention-Sensitive Alerting\*](#)”, In Proceedings of UAI '99, Conference on Uncertainty and Artificial Intelligence (pp. 305-313).

McFarlane, D. C. (1999) “[\*Coordinating the Interruption of People in Human-Computer Interaction, Human-Computer Interaction\*](#)”, INTERACT'99, Sasse, M. A. & Johnson, C. (Editors)

- Information Push and Pull

Cybenko, G. and Brewington, B. “[\*The Foundations of Information Push and Pull\*](#),” in The Mathematics of Information Coding, Extraction, and Distribution (G. Cybenko, D.P. O'Leary and J. Rissanen editors), Springer, IMA Volume 107, 1999.

# *Research Issues*

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- Team Memory

- Targets and Distractors

Clark, S., Hori, A., Putnam, A., and Martin, P. (2000) “*Group Collaboration in Recognition Memory*”, *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26(6):1578-1588.

# Research Issues

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- What You See Is What I See (WYSIWIS)
  - Strict and Relaxed

Stefik, M., Foster, G., Bobrow, D.G., Kahn, K., Lanning, S., and Suchman, L. (1987) “*Beyond the chalkboard: Computer support for collaboration and problem solving in meetings*”, Communications of the ACM, 30(1):32-47.
  - Mutual Orientations

Valin, S., Francu, A., Trefftz, H., Marsic, I. (2001). “*Sharing Viewpoints in Collaborative Virtual Environments*,” In Proceedings of Hawaii International Conference on System Sciences, 3, 1-9.

# Research Issues

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- Information

- Common vs. Private

Stasser, G., Vaughan, S., and Stewart, D., (2000).

*“Pooling Unshared Information: The Benefits of Knowing How Access to Information Is Distributed Among Group Members,”*

Organization Behavior and Human Decision Processes, 82(1):102-116.

# Research Issues

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- Eye Tracking

- Pupil Dilation and Cognitive Load

Marshall, S. P., Morrison, J. G., Allred, L. E., Gillikin, S., & McAllister, J. A. (1997).

*“Eye tracking in tactical decision-making environments: Implementation and analysis”, in Proceedings of the 1997 Command and Control Research and Technology Symposium (pp. 347-355).*

## *FY '02 Research Plan*

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- Explore sharing of pattern chunks
  - Labels
  - Mnemonics
  - Templates (slots)
- Rewards for speed and accuracy